

less stations, at least once daily, and transmit observations oftener when there is a marked change in the barometer; and that there shall be no charge against the Agricultural Department for these observations or for the transmission thereof;

That representatives of the Department of Agriculture and the Bureau of Equipment of the Navy Department be directed to prepare the necessary rules for the harmonious and efficient carrying on of the above recommendations.

We recommend that as fast as the naval wireless-telegraph stations are put in operation the Navy Department be directed to receive and transmit through these stations, free of charge, all wireless messages to or from ships at sea, provided such stations do not come in competition with commercial stations, until such time as Congress may enact the necessary legislation governing this subject.

In asking for legislation on this point, the Board desires to invite attention to the fact that where wireless stations are needed for the merchant marine, as a rule the Navy will also require them. The Board believes it to be in the interest not only of governmental but public economy and efficiency to permit the naval stations to handle the public service, for in the present state of the art but one station is desirable for the public interests in such places. As the needs of the Navy are paramount on account of the problem of national defence, private stations should not be allowed to locate to the disadvantage of the former. Moreover, there is at present no public need for multiplication of stations at these points.

It is admitted, however, that there may be special cases where private stations can serve a useful purpose, and the Board believes that the Department of Commerce and Labor should have the duty of issuing licenses in such cases under such regulations as will prevent interference with stations necessary to the national defence. All private stations in the interior of the country should also be under supervision of the Department of Commerce and Labor.

This method of placing private stations under full Government supervision is desirable in order to regulate them for their mutual and the public welfare, as well as from considerations of national defence. Aside from the necessity of providing rules for the practical operation of such stations, it seems desirable that there should be some wholesome supervision of them to prevent the exploitation of speculative schemes based on a public misconception of the art.

It is believed that invention and private enterprise should be encouraged in every legitimate way, and it is the policy of the Navy Department to do this. It has the means of assisting inventors that no other Department has, and it believes that in order for it to lead the navies of the world in this matter, which is of great importance to the national defence, every reasonable facility should be given inventors, while at the same time it is working out the problems of the application of their inventions to its requirements in times of peace and war.

To prevent the control of wireless telegraphy by monopolies or trusts, the Board deems it essential that any legislation on this subject should place the supervision of it in the Department of Commerce and Labor.

Because international questions may arise, due to the fact that the use of wireless-telegraph stations in our own possessions may affect the use of similar stations in foreign countries, it is desirable for the Congress to enact legislation which will enable the Government properly to handle such cases; a failure to do so may seriously embarrass the Government at some future time.

It is thought that the legislation recommended in placing private stations under the supervision of the Department of Commerce and Labor will also cover this case.

In conclusion, the Board deems it essential that the Executive take such action as in his judgment seems wise to prevent the erection of private wireless-telegraph stations where they may interfere with the naval or military operations of the Government until legislation may be had by Congress on this subject.

Appended hereto are two extracts from the Revised Statutes, marked "W" and "X," which related to the operation of Government telegraph lines; also a decision of the Supreme Court, marked "Y," and the final protocol of the Preliminary Conference of Wireless Telegraph, held in Berlin in August, 1903, marked "Z."²

Very respectfully,

R. D. EVANS,
Rear-Admiral, U. S. Navy,
Representing the Department of Commerce and Labor.
H. N. MANNEY,
Rear-Admiral, U. S. Navy,
Representing the Navy Department.
A. W. GREELY,
Brigadier-General, U. S. Army,
Representing the War Department.
WILLIS L. MOORE,
Chief U. S. Weather Bureau,
Representing the Department of Agriculture.
JOSEPH I. JAYNE,
Lieutenant-Commander, U. S. Navy,
Representing the Navy Department.

MONTHLY WEATHER REVIEW AND WORK OF THE EDITOR.

Prof. Cleveland Abbe's time has been wholly occupied in collecting and preparing material for the MONTHLY WEATHER REVIEW and in preparing and delivering a course of lectures on various problems in physical meteorology. The MONTHLY WEATHER REVIEW has appeared as promptly as practicable, about six weeks after the close of the month whose name it bears. The salient features of the principal articles published in the Reviews for June, 1903, to June, 1904, are worthy of review in this report. From notes furnished by Professor Abbe the following comments are made:

W. N. Shaw: "La lune mange les nuages." A note on the thermal relations of floating clouds (June, 1903). In this the author, who is the chief of the Meteorological Office of London, shows graphically the effect of a slow descent of the air in evaporating the clouds, a phenomenon that occurs regularly every night.

Prof. C. F. Marvin: "The Weather Bureau seismograph" (June, 1903). This describes the apparatus now established at the Weather Bureau and the sources of error in its records. This apparatus was invented by Omori, of Japan, and manufactured by Bosch, of Strasburg. This article has been highly praised in Europe and reprinted by the manufacturer for general use. During the last year a number of earthquake waves have been recorded by this seismograph, and the records have been published in the WEATHER REVIEW. Professor Marvin states that it needs to be supplemented by another smaller apparatus specially designed for the detection of short, minute waves. The present one is designed for the long, slow waves that frequently run several times entirely around the earth before their energy is spent. The Omori apparatus is said to be much more sensitive than the photographic horizontal pendulum of Milne, which is employed at Baltimore, Toronto, and Victoria, but it is apparently not so sensitive as the magnetic needle supported on a quartz fiber, as in the magnetic observatory at Cheltenham, England. The records of the Milne seismograph at certain stations are said to have demonstrated that the areas of high and low atmospheric pressure produce perceptible tiltings of the earth's surface, but the Omori instrument at Washington does not show this, possibly because its location in the basement of the main building does not isolate it sufficiently well from local changes due to temperature and the passage of wagons and individuals.

Harvey N. Davis: "Observations of solar radiation with the Ångström pyrheliometer at Providence, R. I." (June, 1903).

H. H. Kimball: "Observations with the Ångström pyrheliometer" (July, 1903). These reports were referred to in my previous annual report as having been presented and about to be published. Since that time they have been published in full, and have been followed by a general discussion of the whole subject of the sudden variation in the quantity of heat received at the earth's surface that occurred during 1902-3. Some have maintained that this change is due primarily to a change in the amount or quantity of heat that issues from the sun itself. Others, with more plausibility, maintain that it is due to a sudden accession of moisture, haze, or dust in our own atmosphere, and that the changes in the solar radiation or absorption are too small to have caused this change as measured at the earth. Mr. Kimball has continued his own series of observations during the past year at Washington, and if his work is maintained for several years it will doubtless give us additional information. It is very important that the bolograph records secured by Professor Langley should be duplicated by corresponding work at some very dry station having much clear sky, such as are found in our Rocky Mountain and Pacific coast regions.

W. N. Shaw: "On curves representing the paths of air in a special type of traveling storm" (July, 1903). The author deals with a special assumed case in which the speed of the air is assumed to be uniform over the whole area of the storm, although the direction varies from point to point. The isobars are assumed to be true circles, and the wind directions are tangential to them; the center describes a straight path with the same speed as the wind. Many of the conclusions drawn from these assumptions agree with the observations of actual storms. He postpones the consideration of the influence of ascending and descending currents to his next paper, "General circulation of the atmosphere." This has already been received and published in the REVIEW for June, 1904.

D. T. MacDougal: "Soil temperatures and vegetation" (August, 1903). This is a study in the relation between climate and plant growth, and represents the results of several years of work. It would appear that the temperature of the soil is more important than the temperature of the air.

C. G. Knott: "Solar radiation and earth temperatures" (October, 1903). A novel feature of this paper consists in the computation of the accumulation of heat, or the total quantity of heat in the soil at any time of year, as obtained by integrating the expression for the quantity present in each successive layer of soil. The computation shows that at the beginning of September there is a maximum quantity of heat below the surface of the ground and at the beginning of March there is a minimum quantity. At Edinburgh, Scotland, the difference amounts to over 1200 units per square centimeter, or nearly 8000 units to the square inch.

² The papers referred to in this paragraph are omitted from this report.

Prof. F. H. Bigelow: "Studies on the circulation of the atmospheres of the sun and of the earth." (1) The circulation of the sun's atmosphere (October, 1903); (2) The synchronism of the variations of the solar prominences with the terrestrial barometric pressures and temperatures (November, 1903); (3) The problem of the general circulation of the atmosphere of the earth (January, 1904); (4) Values of certain meteorological quantities for the sun (February, 1904); (5) Results of the nephoscope observations in the West Indies during the years 1899-1903 (April, 1904); (6) Circulation in cyclones and anticyclones (May, 1904); (7) Average monthly vectors of the general circulation in the United States (June, 1904).

This long series of papers by Professor Bigelow presents the results of several years of work. It is the opinion of Professor Abbe that the most important conclusion to the meteorologist is the presentation of the facts that in certain portions of the globe the oscillations of temperature are similar to those of the solar phenomena, such as sun spots and prominences, while in other parts of the globe they are opposite, and about an equal number of regions show no decided agreement or opposition. He is of the opinion that terrestrial weather phenomena are the direct result of changes in the pressure and circulation of the earth's atmosphere, and it is not yet certain that these have any connection with the sun. Some are inclined to believe that changes in the sun are the direct or indirect cause of these terrestrial changes. Others believe that the latter would exist even if the sun's radiation were absolutely uniform, and that they represent hydrodynamic and thermodynamic phenomena confined to the atmosphere itself.

Another interesting result of Professor Bigelow's work is presented in his article on the nephoscope work in the West Indies, in which he shows the variation from month to month in the directions of motions of the winds and clouds. The season of hurricanes is distinguished by a special disturbance of the atmospheric circulation. The level of the maximum horizontal velocity changes systematically throughout the year. The mean altitude at which the westward drift reverses to the eastward drift is apparently above six miles in the summer months. The strata from four to six miles high are those chiefly concerned in causing the formation of hurricanes.

Alexander G. McAdie: "Mount Whitney as a site for a meteorological observatory" (November, 1903). This is a report of an expedition by Professor McAdie to the summit of Mount Whitney. The altitude of the mountain has been determined barometrically by a number of observers. Professor McAdie's result is 14,515 feet, but the levelings reported by Prof. Joseph N. LeConte since Professor McAdie's work give 14,434 feet.

Prof. Dr. J. M. Pernter: "Methods of forecasting the weather" (December, 1903); "Promotion of meteorology" (May, 1904). These two articles present an excellent summary of the arguments against the so-called long-range forecasts by means of planetary meteorology, and will do much to stem the tide of popular ignorance and superstition on this subject.

Oliver L. Fassig: "Kite flying in the Tropics" (December, 1903). This summarizes the results of meteorological work by Doctor Fassig on an expedition to the Bahamas under the auspices of the Geographical Society of Baltimore. A number of successful kite ascensions were made from both the land and water, and the temperature, moisture, and wind were determined at various heights up to 4000 feet.

G. C. Abbot: "Recent studies on the solar constant of radiation" (December, 1903). This is a most important publication in which for the first time meteorologists have been favored with quite reliable determinations of the absorbing power of the atmosphere for a number of specific wave lengths, ranging from the visible portion of the spectrum far down into the infra-red. A similar work by Professor Langley has been offered for publication, and a summary will appear in some future number of the WEATHER REVIEW.

Prof. James Dewar: "Problems of the atmosphere" (January, 1904). The author computes the relative quantity of oxygen and nitrogen, carbonic-acid gas, and possible hydrogen up to the outer limit of the atmosphere, and gives important suggestions as to the origin of the aurora and its spectrum.

Gen. H. L. Abbot: "Disposition of rainfall in the basin of the Chagres River" (February, 1904); "Panama meteorology" (June, 1904). These form the conclusion of an important series of papers in which the meteorological data collected by the engineers of the New Panama Canal Company are subjected to discussion by one of the most prominent officers of the Engineer Corps of the United States Army. The great work of Humphreys and Abbot on the Mississippi River has been a standard for fifty years, and his work on the Chagres promises to hold an analogous position as regards that river.

Rev. Marc Dechevreux, S. J.: "Vertical component of the wind" (March, 1904). This article presents the results of observations for several years on the vertical movements of the atmosphere as recorded on the island of Jersey by the use of a special anemometer. The observations are very instructive, although it may be doubted whether they have anything but an extremely local application.

W. B. Stockman: "The winter of 1903-1904." In this article Mr. Stockman gives a detailed record of departures from normal temperatures during the past winter. From New England westward to the Missouri Valley and southwest to the east Gulf States temperatures

were generally below the normal. On the Rocky Mountain slope, the Plateau, and middle Pacific districts temperatures were above normal.

Dr. Edgar Buckingham: "The amount of energy in a unit of light" (April, 1904). This is a very thoughtful paper, revising our knowledge of radiant energy, and showing that to a certain extent we may calculate the temperature of a flame from its radiant energy, but the temperature of an ordinary body can scarcely be thus determined without involving undesirable assumptions.

E. L. Mosely: "The meteor of September 17, 1902" (April, 1904). The author collects the observations and calculates the path of this meteor. The sounds which emanated from it are, however, not explained by him.

R. Assmann: "The temperature of the air above Berlin" (April, 1904). The text and charts illustrate the results of the highest balloon and kite work, and give sections of the atmosphere showing the temperature day by day for fifteen months from October, 1902, to December 31, 1903. These are apparently the most accurate temperatures yet observed in the upper air, and show that at the height of 5000 meters, or over three miles, the changes in temperature from day to day are surprisingly large—but very little less than at sea level. The so-called diurnal variation of temperature is of course very small, but the irregular oscillations, due to the passage of masses of warm air and cold air, are as large in summer as in winter. On the average there is a general inversion of the vertical temperature gradient; that is to say, the stratum between 500 and 2000 meters has an average temperature a little higher than the strata above and below it. The level of freezing point varies between 3000 meters and the ground. The international high balloon ascensions now being carried on in Europe on specified days promise to add more to our knowledge of the atmosphere than was obtainable by the use of high mountain stations; but both of these methods of investigation, as well as the kite work, have become of great importance. Each is specifically adapted to the investigation of some special problem.

S. A. Mitchell: "Pressure of light" (May, 1904). This is an exposition of the latest views accepted by experimental physicists as to the consequences of the well demonstrated fact that a beam of light, or any other form of radiant energy, exerts a pressure in the direction of the propagation. This pressure is inappreciable when the body is large, in comparison with the attraction of gravitation, but becomes the most important item when the body is very small. By virtue of this pressure the finest dust of gaseous particles are repelled from the sun toward the earth and in all directions. When they impinge upon the outer boundary of the earth's atmosphere they may enter it temporarily and influence atmospheric and electric phenomena. These views have received their fullest development at the hands of J. J. Thomson, and at present the subject belongs to molecular and solar physics rather than to meteorology.

W. F. Tyler: "Sensation of discomfort" (May, 1904). The author has attempted to draw curves based upon personal observation showing under what conditions of temperature, wind, and moisture he experienced the greatest discomfort. His idea is quite analogous to that proposed by the editor some years since in which curves of perfect comfort were recommended. Either method seems to offer a convenient way of expressing something analogous to the so-called sensible temperature, and without involving the observer in any unsatisfactory theory.

The cooperation of so many physicists at home and abroad is gratefully acknowledged, and has contributed in an important degree in making the MONTHLY WEATHER REVIEW of increased value to the service as well as to meteorology in general.

THE TEACHING OF METEOROLOGY BY WEATHER BUREAU OFFICIALS.

Meteorologists gratefully recognize the personal interest of the honorable Secretary of Agriculture in the general introduction of meteorology into the courses of study provided by the universities and higher technical institutions of the country. At his suggestion the mode of teaching and the results obtained were made an important part of the work of the convention of Weather Bureau officials at Peoria, Ill., in September, 1904. At fourteen educational institutions Weather Bureau officials, in addition to their regular duties and mainly outside of office hours, deliver courses of lectures on meteorology. The discussion at the convention brought to light the fact that a large amount of work is being done by Weather Bureau men in an educational way. The methods employed are determined by the different needs of the institutions receiving the cooperation of the Bureau, and range from impromptu talks to elaborately prepared lectures with suitable illustrations. The audiences included school classes, teachers' institutes, science associations, and business men's meetings.